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Research Plan To Evaluate the Relationship Between Maneuver Training Activities and Red-cockaded Woodpecker Populations and Habitats on Fort Stewart, GA

Timothy J. Hayden

The U.S. Army must maintain an adequate land base to meet current and future requirements for realistic training and operations in support of its mission. To fuifill long-term mission requirements, the military must achieve environmental objectives of sustainability of training lands and full compliance with conservation requirements under law. The Army is committed to maintaining its role as a national leader in the conservation of threatened and endangered species on Army lands.

The purpose of this research plan is to develop and implement protocols to evaluate the relationship between maneuver training activities and Red-cockaded Woodpecker (RCW) populations and habitats on Fort Stewart, GA. This research plan meets requirements of the 1996 "Management Guidelines for the Red-cockaded Woodpecker on Army Installations" and the U.S. Fish and Wildlife Service (USFWS) October 1996 biological opinion to develop and implement a peer-reviewed monitoring program to evaluate potential training effects on RCWs. It is anticipated that the 1996 Army guidelines will be implemented on Fort Stewart prior to the 2000 RCW breeding season pending completion and approval of the installation's Endangered Species Management Plan.

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Foreword

This research is conducted as a coordinated effort of Fort Stewart, the Construction Engineering Research Laboratory (CERL), and Headquarters, Forces Command (FORSCOM). Fort Stewart provided extensive data collection support and installation access for CERL researchers. FORSCOM provided project review and logistical and funding support. CERL was responsible for project oversight, analyses, and reporting under U.S. Army Corps of Engineers (USACE) project 622720A896, "Base Facilities Environmental Quality," work unit TD9, "Threshold Disturbance of Maneuver Training on TES." This plan has been developed in coordination with Fort Stewart G3 (Directorate of Training), Fish and Wildlife Branch, FORSCOM, and Region 4 U.S. Fish and Wildlife Service.

Tim Beaty (Fort Stewart Fish and Wildlife Branch), Howard Bullard (Fort Stewart G3), Dr. Bert Bivings (FORSCOM), and Ralph Costa (U.S. Fish and Wildlife Service) provided valuable review and comments for early drafts of this report. Dr. Robert Melton (Colorado State University) provided population modeling and analysis. Dr. Tony Kryzsik (ERDC) provided information on statistical analysis and study design. Leslie Jette (Colorado State University) provided information on population biology of red-cockaded woodpeckers.

The work was performed by the Ecological Processes Branch (CN-N) of CERL's Installations Division (CN). The CERL Principal Investigator was Timothy J. Hayden. Dr. Harold Balbach is Acting Chief, CN-N, and Dr. John Bandy is Chief, CN. The CERL technical reviewer was Dr. William D. Severinghaus, CV-T. The technical editor was Linda L. Wheatley, Information Technology Laboratory.

The Director of CERL is Dr. Michael J. O'Connor.

Contents

1 Introduction

Background

The U.S. Army must maintain an adequate land base to meet current and future requirements for realistic training and operations in support of its mission. To fulfill long-term mission requirements, the military must achieve environmental objectives of sustainability of training lands and full compliance with conservation requirements under law. The Army is committed to maintaining its role as a national leader in the conservation of threatened and endangered species on Army lands.

The purpose of the research plan reported here was to develop and implement protocols to evaluate the relationship between maneuver training activities and Red-cockaded Woodpecker (RCW) populations and habitats on Fort Stewart, Georgia. This research plan meets requirements of the 1996 "Management Guidelines for the Red-cockaded Woodpecker on Army Installations" (hereafter referred to as the 1996 Army guidelines) and the U.S. Fish and Wildlife Service (USFWS) October 1996 biological opinion to develop and implement a peer-reviewed monitoring program to evaluate potential training effects on RCWs. It is anticipated that the 1996 Army guidelines will be implemented on Fort Stewart prior to the 2000 RCW breeding season pending completion and approval of the installation Endangered Species Management Plan (ESMP).

Objectives

This document outlines necessary research protocols and data requirements to evaluate the following research objectives:

- Meet monitoring and reporting requirement of 1996 Army RCW management guidelines and October 1996 USFWS biological opinion.
- Determine if any relationship exists between training activity and RCW population and habitat parameters.

- Develop an approach to characterize training activity in endangered species habitats with minimal disturbance of mission activities.

- Provide generic approaches for evaluating training effects that could be widely implemented on Army installations in compliance with the 1996 Army RCW guidelines.

Approach

A draft of this research plan was submitted by CERL on behalf of Fort Stewart to the USFWS for peer review on 8 April 1997. USFWS subsequently submitted the draft plan to three independent experts for their review. USFWS forwarded reviewer comments to CERL in June 1997. Concurrent with this review process, preliminary research studies were initiated on Fort Stewart during the 1997 RCW breeding season (March – July) in accordance with protocols of the draft research plan submitted to USFWS. Reviewer comments and lessons learned from preliminary research activities were incorporated as changes in this final plan, which is incorporated in the Fort Stewart ESMP by reference.

The research plan first outlines experimental considerations and limitations. Within these constraints, the plan identifies null hypotheses for evaluation, data parameters necessary to test hypotheses, sampling protocols, and data summary and analyses requirements.

The research approach relies primarily on observational data to investigate the relationship of maneuver training activities and RCW demographic and habitat parameters. The null hypotheses are formulated based on the availability of observational data to test measures of association. This approach in general will not establish cause-and-effect relationships between maneuver training activity and RCW demographic and habitat parameters. However, this approach is designed to provide adequate information to make informed evaluations and decisions regarding protective requirements for RCW populations and habitats.

Scope

The scope of this research plan is limited to evaluating activities allowed under the 1996 Army guidelines associated with maneuver training activities occurring in primary RCW clusters and supplemental recruitment clusters on Fort Stewart. These activities include transient troop and vehicle movements, firing of individual and crew-served weapons and weapons simulators, and excavation of

hasty fighting positions. In supplemental recruitment clusters, training activities may include fixed activities exceeding 2-h duration (1996 Army guidelines). Results of this research will apply specifically to Fort Stewart; however, results will be evaluated for application to other installations with RCWs in the southeastern United States.

This plan will not address effects of military training in non-maneuver areas such as direct fire ranges and impact areas, and does not address effects of aircraft overflights. This plan also does not specifically address potential noise effects except to the extent that it is an integral characteristic of transient maneuver training. Specific evaluation of potential training-related noise such as blast noise will be conducted under a separate research effort funded by the Department of Defense Strategic Environmental Research and Development Program (SERDP). Noise impacts research was initiated in Fiscal Year 1998 (FY98).

Mode of Technology Transfer

This research plan was published for distribution as a CERL Technical Note. Results from implementing this research plan will be submitted for publication in peer-reviewed journals and will be distributed to installations implementing the 1996 "Management Guidelines for RCWs on Army Installations."

Units of Weight and Measure

U.S. standard units of measure are used in this report. A table of conversion factors for Standard International (SI) units is provided below.

SI conversion factors		
1 ft	=	0.305 m
1 yd	=	0.9144 m

2 Research Plan Considerations and Limitations

Installation Selection

Fort Stewart was selected as the host installation for this research based on a number of factors. First, it is the only Army installation in the southeastern United States that supports training for a "heavy" mechanized division, the 3rd Infantry Division (Mechanized). This division trains with a full complement of tracked vehicles including the M1Abrams main battle tank and the Bradley armored fighting vehicle. Military units on Fort Stewart conduct the full spectrum of training events that are required to maintain readiness for combat and associated support functions.

Second, Fort Stewart supports a significant population of RCWs and is designated as a recovery population. In 1996, 168 active clusters were documented on Fort Stewart. Fort Stewart has a mature program for management of RCWs on the installation and has been conducting comprehensive population monitoring since 1994. Finally, the installation training and natural resource management staff have provided key and necessary support for implementing this research on Fort Stewart.

Research Design and Approach

A primary challenge in evaluating potential impacts of maneuver training on RCW populations and habitats is characterizing and quantifying maneuver training in an environmental context. "Maneuver training" is not a specific entity that can be easily quantified and described. It is a complex interaction of events, participants, and equipment that is highly dynamic and variable both spatially and temporally. Another major challenge of any study implemented at the landscape scale is quantifying the temporal and spatial variability and stochasticity of the natural system under consideration.

This high degree of dynamic variability both in the natural system (RCW populations and habitats) and the factors (maneuver training and RCW management)

potentially affecting these systems presents several difficulties in developing approaches to evaluate potential impacts of maneuver training on populations or habitats. First, the spatial and temporal variability of maneuver training as it is conducted under actual conditions has not been well documented and currently cannot be easily predicted at the site-specific level — there is no baseline data to establish experimental levels for training that reflect predicted or anticipated levels of training activity. Second, given the inherent complexity in the characteristics of maneuver training, extreme care must be given to constructing appropriate hypotheses that can be evaluated given the complexity of the system and factors under consideration.

Data necessary to test established hypotheses can be derived from either of two fundamental research approaches — experimental designs and observational studies. The resulting inferences and conclusions drawn from analyses of the data will depend on the approach selected. The advantages and limitations of experimental and observational studies as they relate to objectives of this study and alternatives considered in this study design are discussed in the remainder of this chapter.

Experimental Design

The advantage of implementing an experimental design is that experimental factors (treatments) and response (outcome) can be identified and analyzed in a manner that can establish causal relationships between the experimental factor(s) of concern and the observed response or outcome. The primary limitation of an experimental design is that all sources of variance in the results must be accounted for to establish these causal relationships. A multifactorial experimental design incorporating all aspects and potential levels of maneuver training activity would be hopelessly complex and expensive to implement. This also does not consider that it is often difficult to account for or control all sources of variance in field experiments conducted in a natural system on a landscape scale, as would be required to meet objectives of this study.

However, hypotheses can be formulated and tested that address relevant questions regarding effects of implementing the 1996 Army guidelines and effects of maneuver training. Two hypotheses amenable to experimental design and their implementation requirements and limitations are discussed next.

(1) A reduction in training restrictions on maneuver training activities in cluster sites under the 1996 Army guidelines has no effect on RCW demographic or habitat parameters of concern.

The experimental factor under this hypothesis would be training restrictions in RCW cluster in ranges used for maneuver training. Experimental levels would be "maneuver training restrictions under the 1994 Army guidelines" and "maneuver training restrictions under the 1996 Army guidelines."

To minimize variance in observed results due to demographic, spatial, or temporal variability, and to establish causal relationships (i.e., reduction in restrictions caused some observed result), samples for each experimental level would need to be randomly selected from the same population and data collected concurrently for each sample population. This requirement precludes spatially segregated sample populations (e.g., populations on the west side of the installation under 1994 guidelines and populations on the east side under 1996 guidelines) or comparisons between years (e.g., first year of data under the 1994 Army guidelines and second year of data under 1996 Army guidelines).

Such an experimental design would require troops to train under two different sets of training guidelines simultaneously. One of the primary objectives in developing Army-level guidelines for RCW management agreed upon by both the Army and USFWS was to establish one Army-wide standard for training in RCW habitats. It is highly unlikely that troops in the field could be adequately trained to recognize and, for experimental validity, to adequately adhere to two different, concurrent standards for training activity in cluster sites.

Also note that this design in itself does not directly address effects of training since level of training activity is unknown for either experimental level. The only conclusion that can be drawn is whether the level of training restriction has any effect on RCW populations or habitats. Some measure of training activity in each sample population would be required to assess differences in training activity in cluster sites as a result of reduced training restrictions. Without these data for example, failure to reject the hypothesis could imply that restrictions are irrelevant merely because no training is occurring in clusters regardless of the level of training restrictions.

(2) Training restrictions have no effect on RCW demographic or population parameters.

Although this hypothesis appears to be only a slight rewording of hypothesis (1), it has significant implications for implementing an experimental design on a

military installation. To test this hypothesis, the experimental factor is training restrictions. The experimental levels would be "training restrictions implemented" and "no training restrictions implemented." "Training restrictions implemented" could be in accordance with any restriction standard, but any restriction standard implemented would have to be consistent for the entire sample population for the experimental level with training restrictions.

This design would meet logistical requirements to implement one training restriction for troops to recognize and follow. This restriction would likely increase the chance of compliance with requirements of the experimental design. The sample population for the experimental level with no restrictions would essentially be "invisible" to troops for training purposes and thus would have no compliance requirements for troops from an experimental perspective.

Again note the same limitations on conclusions drawn from this design without concurrent data on the level of training activity in cluster sites. Without data to characterize training activity in cluster sites, failure to reject the hypothesis could imply only that the level of restriction implemented is inadequate to limit training activity in restricted clusters relative to unrestricted clusters.

Also, while such a design could be implemented immediately, implementation could be problematic from a conservation perspective. Analyses of available data from Fort Bragg indicate sample populations in excess of 25 would be required to achieve adequate statistical power (Kryzsik, unpublished data). This requirement would mean that protective restrictions would have to be removed from a fairly large proportion of the known population on an installation such as Fort Stewart, with the risk of potentially increased negative effects in this sample population.

Although supplemental recruitment clusters will eventually provide a sample of unprotected clusters on some installations, they do not represent a random sample from the population. Causal interpretations of analyses based on comparison of supplemental recruitment clusters (no training restrictions) with primary recruitment clusters (training restrictions implemented) may not be valid.

Observational Studies

Observational studies are based on data derived from sources beyond the control of the investigator (although the investigator has control over how these data are collected). Observational data can be used to identify trends and test hypotheses

of association between independent (predictor) variables and dependent (response) variables.

However, the greatest limitation or misuse of observational data is that it cannot be used to establish causal relationships. At best, causation can only be inferred from results of observational studies based on examination of all conceivable alternative hypotheses and cannot be inferred based on results of statistical analyses alone.

In a conservation context, the danger due to inappropriately inferring causal relationships from observational data, is that management decisions based on spurious determination of causal relationships can at worst lead to catastrophic effects on RCW populations of concern and at the least lead to inefficient use of fiscal and personnel resources. Management decisions and policies based on observational data should only be implemented after careful consideration of all available alternative data sources, expert knowledge, and potential costs of implementing incorrect policies.

The use of observational data to address objectives of this study will require careful interpretation of statistical measures of association among training activity, RCW demographic, and habitat variables. These interpretations will be based on expert knowledge and concurrent management practices. The implications for evaluating and potentially modifying protective measures under the 1996 Army guidelines based on observational data depends on whether an association is observed between maneuver training and RCW populations. Given that management practices under the 1996 Army guidelines are intended to maximize RCW population growth on installations, failure to reject null hypotheses of association between training and RCW populations would indicate that maneuver training activities at the level observed are not limiting factors for RCW populations. Any observed negative relationship between maneuver training and RCW populations likely would lead the USFWS to maintain or increase protective measures. If the latter outcome were based on an incorrect inference of causal relationship between training and RCW populations, the cost to maintain or increase training restrictions (although likely to be undesirable from a military perspective) would be benign from a conservation standpoint. The monetary costs (in terms of dollars available for conservation management versus research) of this potential outcome would be a reasonable trade-off with the monetary costs associated with implementing an experimental design to unequivocally establish causal relationships.

3 Research Methods

Based on the research design considerations discussed in Chapter 2, the approach for this research relied primarily on observational data to investigate the relationship of maneuver training activities and RCW demographic and habitat parameters. The null hypotheses outlined here are formulated based on the availability of observational data to test measures of association. This approach in general will not establish cause-and-effect relationships between maneuver training activity and RCW demographic and habitat parameters. However, this approach is designed to provide adequate information to make informed evaluations and decisions regarding protective requirements for RCW populations and habitats.

Null Hypotheses

The following null hypotheses (H_0) will guide data collection, summary, and statistical analyses to characterize maneuver training activity in RCW clusters and evaluate relationships between maneuver training activity and RCW populations and habitats.

- No relationship exists between RCW demographic parameters and frequency, duration, or intensity of maneuver training activity conducted in accordance with the 1996 Army guidelines.

- No relationship exists between habitat/site characteristics and frequency, duration, or intensity of training activity conducted in accordance with the 1996 Army guidelines.

- No difference exists between RCW demographic parameters in monitored primary clusters versus supplemental recruitment sites.

- No difference in frequency, duration, or intensity of training activity exists between monitored primary clusters and supplemental recruitment clusters.

Sample Plot Location

All training, demographic, and habitat data will be collected at the RCW cluster sites listed below. Sample clusters will be randomly selected from RCW primary clusters in which demographic monitoring of RCW populations is conducted by Fort Stewart biologists and in all supplemental recruitment clusters identified by these biologists. Sample clusters are limited to maneuver ranges in training areas A, B, C, E, and F due to prevalence of maneuver training activities in these areas. No sample clusters will be located in designated firing ranges or impact areas.

- A minimum of 50 monitored cluster sites will be selected for data collection and analysis. A minimum of 30 sites will represent breeding pairs. The number of supplemental clusters monitored will depend on the rate of installation initiation of these sites.

- A sample plot will be established in randomly selected cluster sites with full population monitoring. One sample plot will be established in each selected primary cluster centered on the last known nest cavity tree, a randomly selected active cavity tree, or a cavity tree suitable for occupation within the cluster if no nest cavity tree has been identified previously. An initial sample plot will be relocated if the monitored RCW group initiates a nest in a new or different cavity tree in the cluster. Only one sample plot per cluster will be established to ensure independence of samples.

- A sample plot will be established in all sites identified as potential supplemental recruitment clusters.

Training Data Collection

The approach is a point sample of training activity in association with monitored RCW primary clusters and supplemental recruitment clusters. This protocol requires minimal interaction with training units. The advantages of this approach are that it (1) characterizes training activity under actual conditions, (2) provides data that are easily statistically manipulated and analyzed, and (3) requires minimal interaction with unit training so that the training "behavior" is not influenced by researcher observation.

Sample Period

- At each sample site, a 10-min observation period will be conducted. This time period was selected as the median of the expected maximum duration of training activities (20 min) in clusters based on information provided in the biological assessment of the 1996 Army guidelines.

- Any observed training activity exceeding 10 min within 200 ft of cavity trees will be observed up to a total of 2 h of continuous observation. The 2-h time limit was selected based on the 2-h limit (1996 Army guidelines) on training activity in cluster sites. Training activity may exceed 2 h and will be documented, but would not be considered transient under the 1996 Army guidelines. Sites where training in excess of 2 h is observed will be visited in subsequent 24-h periods to document continued occupation of the cluster site by training activity.

- All activity in proximity or adjacent to the cluster site but outside 200 ft of cavity trees will be recorded and monitored as described above.

Sample Size

- Training data will be collected at a minimum of 50 primary clusters during FY98-00. A minimum of 30 of these sites will represent breeding pairs.

- Conservatively, a total of 680 (approx. 14 / cluster) 10-min observation periods per month will be conducted in the 50 primary cluster sites based on 20 days of sampling effort per month during the period of 1 April through 31 July. Total observation period for this level effort would be 108 h per month (exclusive of training events exceeding 2 h).

- Training data will be collected in all supplemental recruitment clusters as they are established by installation biologists.

Sampling Protocol

The following protocol was developed to balance sampling efficiency with temporal and spatial randomization and representation of sampling observations.

- Sample clusters will be allocated into sample groups to increase travel efficiency between cluster sites.

- Observations in sample groups will be conducted in one of three diurnal periods: Morning – sunrise to 4 h post-sunrise; Mid-Day – 4 h post-sunrise to 4 h before sunset; Evening – 4 h before sunset to sunset.

- Observations in sample groups will be rotated among diurnal periods. For example, on Day 1 sample group "A" will be sampled during the "Morning" period and sample group "B" will be sampled during the "Mid-Day" period. On Day 2, sample group "A" will be sampled during the "Mid-Day" period and sample group "C" will be sampled during the "Evening" period, etc.

- Within each sample group the initial cluster sampled in a sampling period will be selected by a random draw.

- A sampling rotation will be completed prior to resampling of any individual sample plot.

Training Data Recorded at Sample Sites

See sample data table (Table A1 in the appendix) for training data fields recorded during sample periods. For each event observed, further details and narrative description will be recorded in event description logs (see Table A2).

- Unit type: (M) = military, (C) = civilian, (FW) = installation Fish & Wildlife Branch personnel, (DPW) = installation Directorate of Public Works personnel, (F) = installation Forestry Branch personnel. Additional details recorded in event description log.

- Activity description: Recorded in event description log.

- Vehicle type and number: Number of vehicles and type in 200-ft proximity to cavity tree: (M1) = M1A1 main battle tank, (MBT) = main battle tank — other, (B) = Bradley armored fighting vehicle, (APV) = armored personnel carrier and variants other than Bradleys, (SPA) = self-propelled artillery, (HV) = HMMWV and variants, (PU) = wheeled pickup, 4x4, and utility vehicles other than HMMWV, (HW) = heavy wheeled vehicles, larger gross tonnage than HMMWV. Additional detail recorded in event description log.

- Personnel number: number of dismounted soldiers and civilians in 200-ft proximity to cavity tree. Additional detail recorded in event description log.

- Duration of activity within 200 ft of cavity trees. Recorded from beginning of sample period up to 2 h total observation. For purposes of the statistical

summary and analysis, the beginning of the sample period will be considered the median point for duration of the observed training event. Average event duration will be estimated by 2*(sum of observed events duration) / total number of events observed.

- Description of any fixed activity in visible range of cavity trees regardless of distance.

- Type and duration of weapons firing within 200 ft of cavity trees. Recorded in event description log.

- Type of weapons firing audible at sample site regardless of distance (e.g., artillery, simulators, small arms, machine guns, M1/Bradley firing).

Training Data From G3 Range Scheduling Records

Data for ranges in which sample clusters are located will be used to correlate scheduled training activity with field observations of training frequency, duration, and intensity.

- Unit type scheduled (e.g., armored, mechanized infantry, infantry, artillery, combat support, command and control)

- Unit size scheduled (e.g., battalion, company, platoon)

- Activity type scheduled

- Duration of scheduled activity: Dates/days activity scheduled.

- Ranges scheduled.

RCW Demographic Data

RCW demographic data for monitored primary clusters and supplemental clusters will be collected in accordance with methods established and implemented by the Fort Stewart Fish and Wildlife Branch, DPW. These data have been collected in monitored clusters since 1994. Data collection methods follow standard methodologies documented elsewhere and will not be further elaborated here.

However, demographic parameters that can be derived from baseline monitoring data collected on Fort Stewart include:

- Cluster activity status: Active = occupation by one or more RCWs. This parameter provides a measure of recruitment rate in cluster sites.
- Mated status: Presence of adult male and female RCW. This parameter provides a measure of adults ability to attract and retain mates.
- Group size: Total number of mated adults and auxiliaries occupying cluster site. Provides a potential covariate for reproductive success.
- Nesting attempt: Provides a measure of breeding adults' capacity to initiate nesting attempts.
- Number of young fledged: Provides a measure of fecundity.
- Site tenacity: Turnover of adults and auxiliaries of each sex in cluster sites based on observations of banded birds. This parameter provides a measure of a cluster site's ability to retain RCWs, particularly potential breeders.

Habitat / Site Characterization Data

Vegetation and site data will be collected at sample plots during July and August. Vegetation data collected at each sample plot:

- Stand data: Basal area, pine species, and stem counts by DBH* class. Data will be collected by point sampling using wedge prism. DBH will be recorded to 1.0 cm.
- Ground, midstory, and canopy cover. Data collected at 100 points along transects associated with cavity trees. Midstory and canopy cover estimated for hardwood and conifer. Ground cover will be recorded as bare soil, litter, grass, wiregrass, or forb.

* DBH = diameter at breast height.

Site data collected at each sample plot:

- Distance to nearest neighboring active cluster
- Sample plot location: cluster site, sample plot cavity tree number, UTM* coordinate, and training area
- Management history: Including available record of prescribed burns, mechanical or herbicide midstory control, cavity inserts or drilling, timber harvest
- Soil type
- Elevation and slope
- Measures of access for training activity: Distance to nearest road/trail, location and distance relative to wetland/aquatic landscape features (i.e., available access for training activity).

* UTM = universal transverse mercator

4 Data Summary and Analyses

Summary Statistics

Appropriate summary statistics will be reported for the following data.

- Training data collected at sample sites
- Training scheduling data
- RCW demographic data at sample sites
- Vegetation/site data.

Statistical Analyses and Tests

Appropriate parametric and nonparametric analyses and tests to evaluate null hypotheses will be selected pending results of preliminary examination and summary of data. Due to the observational nature of the sample data, analyses will rely primarily on techniques of regression and correlation. Dependent variables of interest will include population and habitat measures as identified in Chapter 3 under "RCW Demographics Data" and "Habitat / Site Characterization Data." Independent variables and covariates will be those measures identified in Chapter 3 under "Training Data" and "Habitat / Site Characterization Data." Tests of effects will emphasize effects on breeding pairs. However, parameters for abandoned and single male clusters will be examined for effects due to training activity. The main comparison of interest in these latter two groups will be between supplemental recruitment sites and primary recruitment sites. Exploratory analyses of abandoned, single male, and initially inactive sites may be limited during the period of this study by low sample size. To reject a null hypothesis for all tests, an $\alpha = 0.10$ and a power = 0.80 will be required. A statistical power = 0.80 will be required to accept a null hypothesis. An $\alpha = 0.10$ is selected to improve the statistical power of tests. It is a conservative value from a conservation standpoint.

Appendix: Sampling Tables

Table A1. Sample data form for training events.

Cluster	Tree	Date	Start Time	Event Time	Unit Type	# Troops	# Vehicles	Duration

Table A2. Sample narrative descriptive log for training events.

Cluster/site _____ Date Tree # _____
DESCRIPTION

Cluster/site _____ Date Tree # _____
DESCRIPTION

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Timothy J. Hayden

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U.S. Army Construction Engineering Research Laboratory (CERL)
P.O. Box 9005
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13. ABSTRACT *(Maximum 200 words)*

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The purpose of this research plan is to develop and implement protocols to evaluate the relationship between maneuver training activities and Red-cockaded Woodpecker (RCW) populations and habitats on Fort Stewart, GA. This research plan meets requirements of the 1996 "Management Guidelines for the Red-cockaded Woodpecker on Army Installations" and the U.S. Fish and Wildlife Service (USFWS) October 1996 biological opinion to develop and implement a peer-reviewed monitoring program to evaluate potential training effects on RCWs. It is anticipated that the 1996 Army guidelines will be implemented on Fort Stewart prior to the 2000 RCW breeding season pending completion and approval of the installation's Endangered Species Management Plan.

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